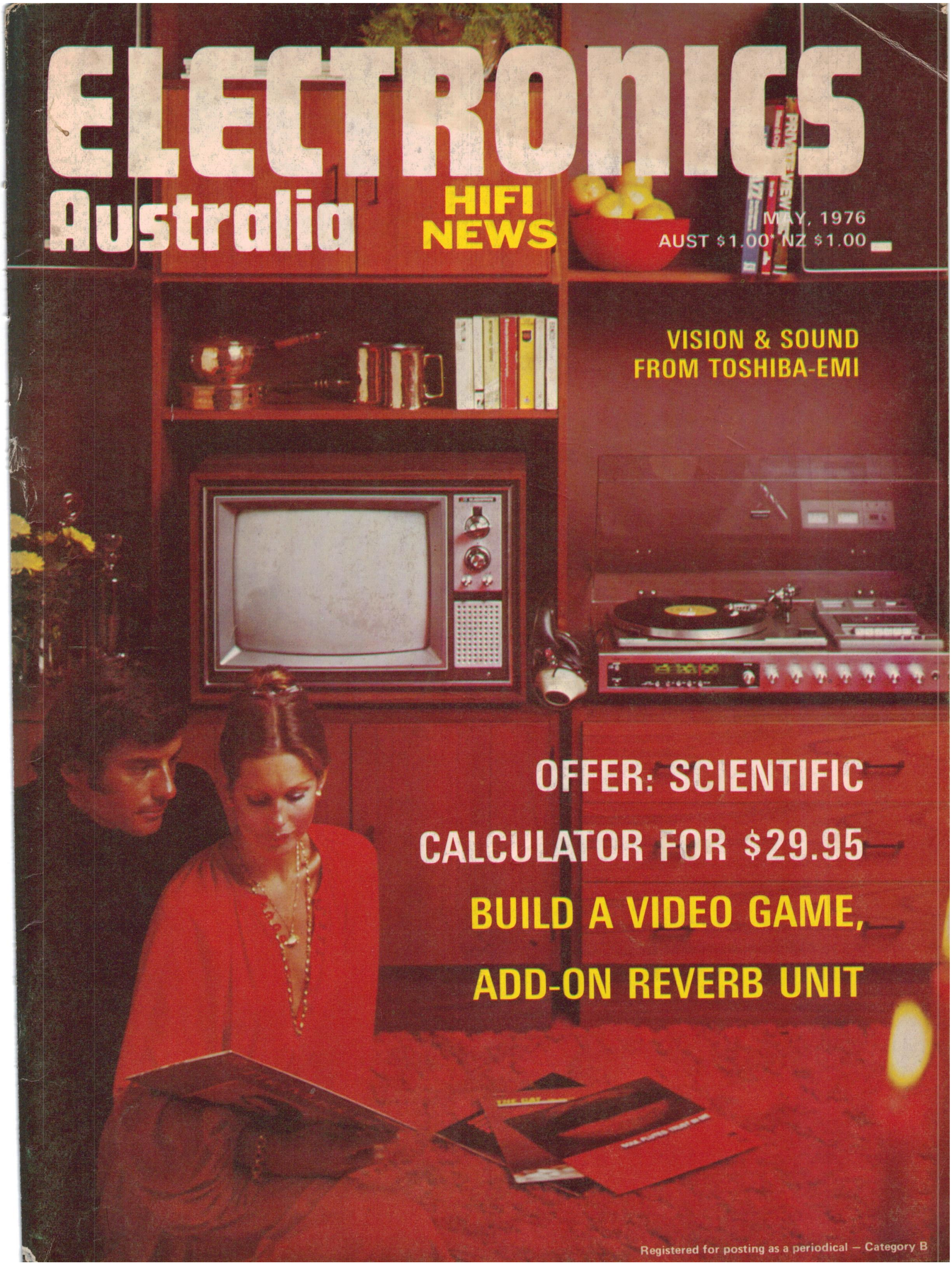


ELECTRONICS Australia

HIFI NEWS

MAY, 1976
AUST $1.00* NZ $1.00

VISION & SOUND FROM TOSHIBA-EMI

OFFER: SCIENTIFIC CALCULATOR FOR $29.95

BUILD A VIDEO GAME, ADD-ON REVERB UNIT

Registered for posting as a periodical — Category B

Hours of fun for the whole family!

Build your own Video Ball Game

Do you find TV programs boring? If so, help is at hand. Our Video Ball Game will provide hours of fun, for all your family and friends. Using only thirteen CMOS ICs and a number of discrete components, the kit is easily assembled on a printed circuit board.

by DAVID EDWARDS

In recent months a large number of home video games have come onto the market. These usually cost in the vicinity of $100.00 or more, and are available either as fully assembled units or in kit form. Our Video Ball Game should cost you considerably less than this to construct—in fact it should cost you only about $40.

Used in conjunction with a standard VHF TV set, either colour or black and white, the unit produces a display similar in outline to that of a tennis court or ping-pong table. There is a central dotted vertical line, called the net, and upper and lower boundaries from which a small rectangular "ball" can be bounced.

Along the side boundaries may be moved small "bats", which can be controlled by two players using small hand-held units. The players move their bats up and down, hitting the ball to keep it in play. A player scores a point when his opponent misses the ball, and allows it to continue off the court.

The ball is brought back into play by pressing the appropriate serve button. Each player is provided with one of these buttons on his control unit.

The speed at which the ball moves, and hence the rate of play, is varied by a control on the front of the case.

Small slider switches are used to alter the display, allowing several types of games, by one or two players, to be played.

Turning now to the main circuit diagram, we can see how the display is produced, and how the design is implemented. 74C series CMOS logic has been used in the design, with gates functioning both in the normal digital manner and also as linear amplifiers. In addition to the CMOS gates, four discrete transistors have been used, as well as a number of diodes.

The box labelled "modulator" is a self-contained unit, which converts the video information generated by the remainder of the circuit into a form suitable for decoding by a standard VHF TV set. It is connected directly to the aerial terminals of the TV, and is described in detail later in the article.

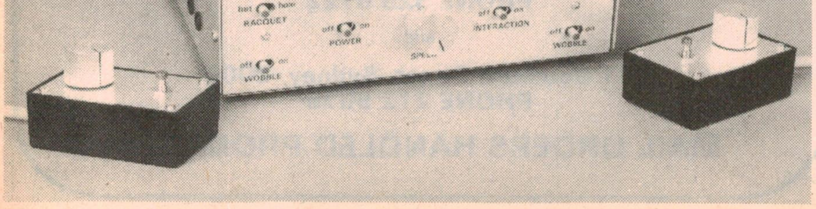
Before commencing with a detailed description of the circuit operation, we will digress for a short time, and explain the way in which the IC gates have been identified. Only two types of ICs have been used, the 74C00 type, which is a quad NAND gate, and the 74C02 type, which is a quad NOR gate. Each of the individual gates in each IC has been labelled "a", "b", "c" or "d", while the ICs themselves have been numbered consecutively. Thus gate 1a is the first gate in the first IC. The pin numbers of each gate are shown next to the respective terminations.

Five NAND gates, 1a, 1b, 1c, 1d and 3a are connected as a free running horizontal sweep oscillator. The horizontal hold control is used to set the operating frequency to about 15625Hz. In operation, a "low" pulse circulates through the gates, producing appropriate outputs at each gate. D1 ensures reliable starting and operation.

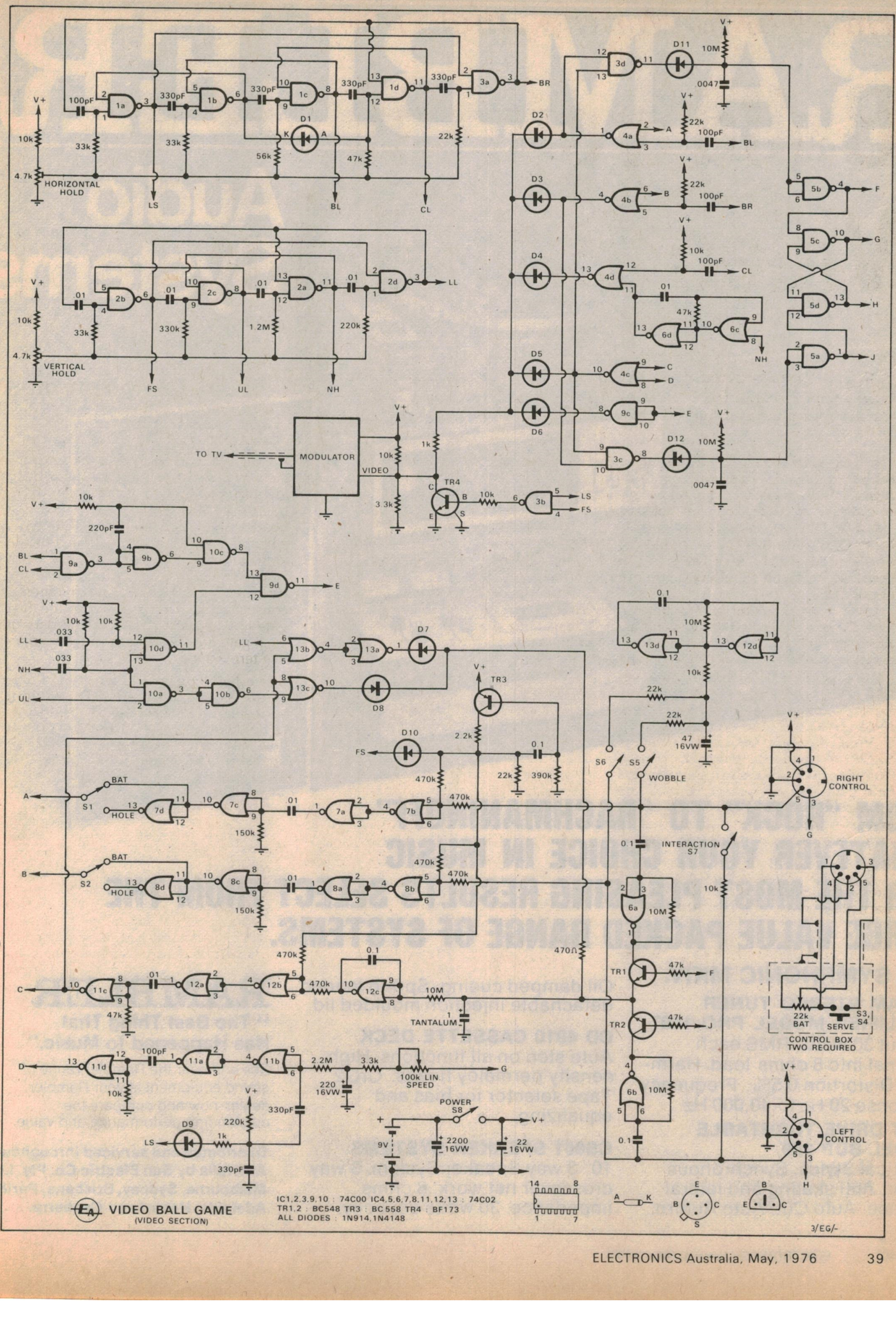
The line sync (LS), bat left (BL), centre line (CL) and bat right (BR) pulses produced by this oscillator determine the horizontal spacing of the display.

Four NAND gates, 2b, 2c, 2d and 2a are connected as another free running oscillator, this time with a frequency of about 50Hz. This oscillator produces the frame sync (FS), upper line (UL), net height (NH) and lower line (LL) pulses, which determine the vertical spacing of the display.

The LS and FS pulses are added together by gate 3b, to form a composite sync pulse, which is then injected into the video line by TR4. The LS and FS pulses



At left is a photograph of the completed Video Ball Game, showing the hand-held control units. On the facing page is the circuit diagram. Circuit details of the modulator are given later in the article.


HORIZONTAL HOLD
VERTICAL HOLD
MODULATOR
TO TV
VIDEO
RIGHT CONTROL
LEFT CONTROL
CONTROL BOX TWO REQUIRED
BAT
SERVE
WOBBLE
INTERACTION
POWER
100k LIN SPEED
TANTALUM
HOLE
IC1,2,3,9,10 : 74C00 IC4,5,6,7,8,11,12,13 : 74C02
TR1,2 : BC548 TR3 : BC558 TR4 : BF173
ALL DIODES : 1N914,1N4148
VIDEO BALL GAME
(VIDEO SECTION)
3/EG/-

are also used to generate line and frame ramps. The line ramp is produced by D9 and its associated components. The ramp is positive going, and is reset when the LS pulse discharges the 330pF capacitor through D9 and the 1k resistor.

The frame ramp is produced by TR3 and its associated components. A linear positive going ramp is produced as the 0.1uF capacitor discharges through TR3, connected as a Miller integrator. The capacitor is charged by the FS pulse, via D10.

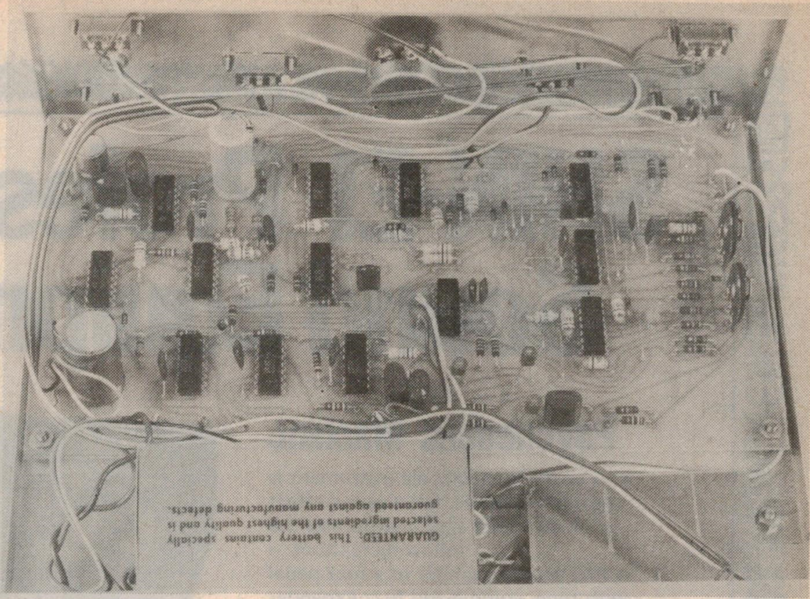
Gates 6c and 6d are connected as a free running oscillator, with a frequency of about 1000Hz. This oscillator is gated on and off by the NH pulse connected to pin 8. The oscillator output is combined in gate 4d with a differentiated CL pulse, and injected into the video line by D4. This forms the central dotted line called the net.

The two 22k bat controls are connected as potential dividers across the supply lines. The bat voltages are added to the frame ramp at the inputs to gates 7b and 8b. These gates act as comparators, and produce negative going transitions at their outputs whose positions with respect to the FS pulse vary directly with the positions of the bat controls.

These edges are squared up by gates 7a and 8a, and then differentiated. The differentiator time constants determine the vertical heights of the bats. The differentiated pulses are squared up by gates 7c and 8c, and then inverted by gates 7d and 8d. The bat pulses or their complements are selected by S1 and S2, and then passed to the inputs of gates 4a and 4b.

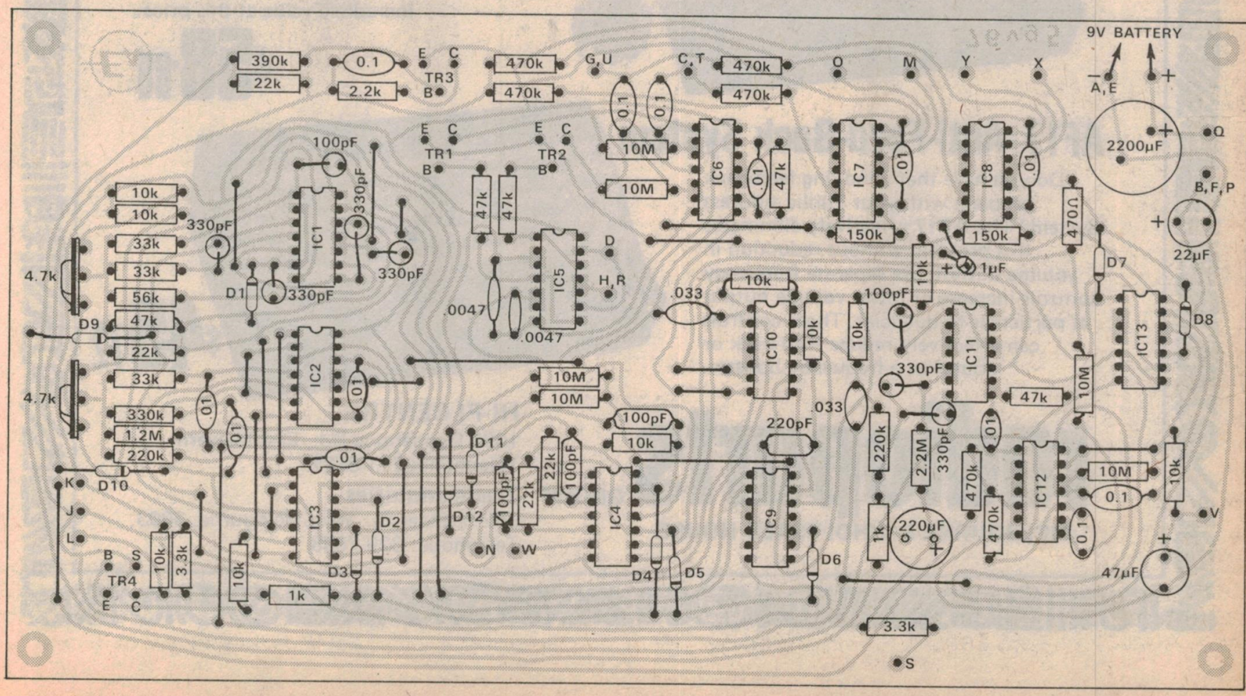
The BL and BR pulses are differentiated and fed to the remaining inputs of gates 4a and 4b. The width of these differentiated pulses determines the horizontal widths of the bats. The horizontal and vertical components of the bats are summed by gates 4a and 4b, and injected into the video line by D2 and D3.

As with the bats, the horizontal and vertical components of the ball are generated separately. The vertical velocity of the ball is represented by the voltage stored on the 1uF tantalum capacitor. This velocity is integrated by gate 12c, and the resultant voltage, which represents the vertical position of the ball, is added to the frame ramp at the input of gate 12b, to produce a negative going edge representing the vertical



This shot from the rear shows clearly the internal disposition of the component parts. The modulator assembly is shown in the lower right hand corner.

The printed circuit board component overlay is shown below. Pay particular attention to the polarity of diodes, electrolytic capacitors and integrated circuits.



Build your own Video Ball Game

position of the ball.

This edge is squared up by gate 12a, and then differentiated to produce a pulse proportional to the height of the ball. This pulse is squared up by gate 11c, and fed to one input of gate 4c, and to the inputs of gates 13b and 13c.

Consider first the case when the ball is descending. The 1uF capacitor will be charged to a higher voltage than the threshold of gate 12c, and its output will be falling. When the ball reaches the bottom of the "court", gate 13b will register coincidence between the ball pulse and the LL pulse. The resulting output pulse is inverted by gate 13a, and discharges the 1uF capacitor via D7 and the 470 ohm resistor.

The integrator output (gate 12c) will now commence to rise, and so the ball will "bounce" off the lower line, and commence to approach the upper line. When this occurs, a coincidence is registered between the ball pulse and the delayed UL pulse. (This pulse is delayed so that the ball will bounce off the bottom of the upper line.)

The positive pulse from gate 13c will now charge the 1uF capacitor again, via D8 and the 470 ohm resistor. Thus the ball is constrained to stay between the upper and lower lines on the court.

The voltage on the 220uF electrolytic capacitor represents the horizontal position of the ball. This voltage is added to the line ramp at the input of gate 11b, producing a negative going transition at the output corresponding to the horizontal position of the ball. This is squared up by gate 11a, differentiated, and then squared up again by gate 11d. The width of the ball is determined by the differentiator time constant.

The horizontal and vertical components of the ball are added together by gate 4c, and then injected into the video line by D5. Gates 3c and 3d detect coincidence between the ball and the left and right bats. These coincidence pulses are stretched by D11 and D12 and their associated circuitry, and then squared up by gates 5a and 5b.

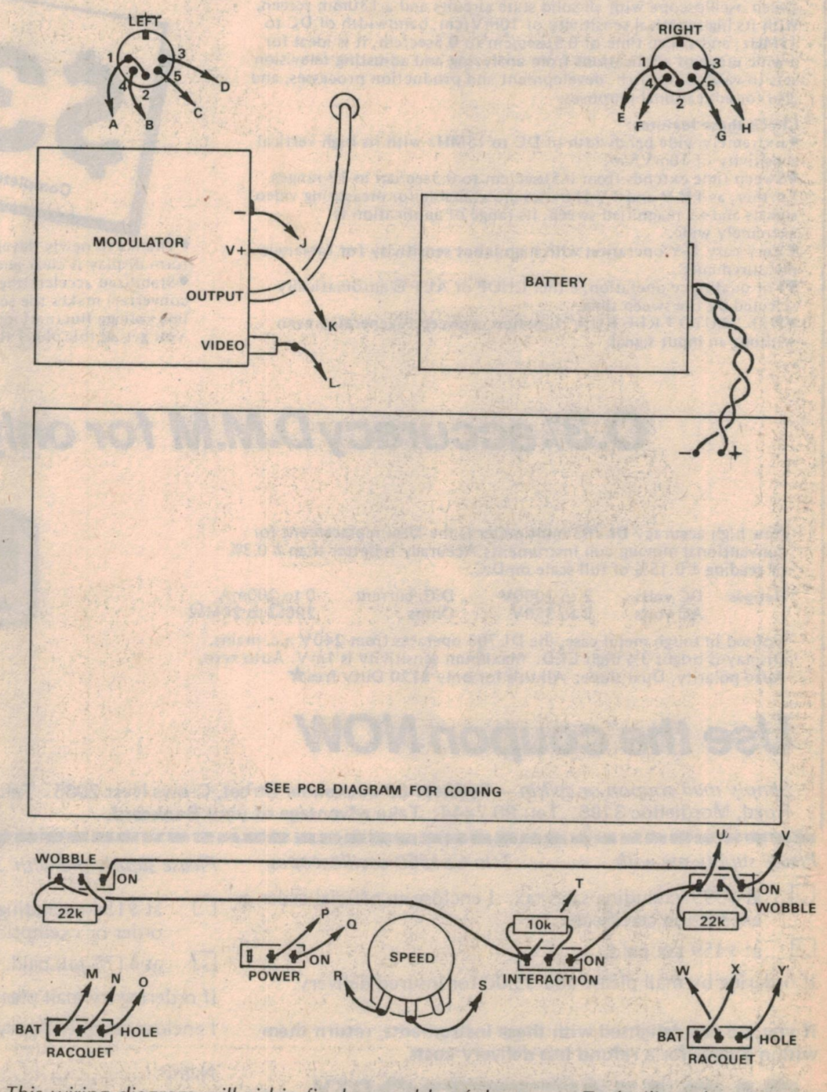
Gates 5c and 5d are connected as a flip-flop, and used to control the horizontal direction of the ball. If the ball is moving to the right, the output of gate 5c will be low, and the 220uF capacitor will be discharging via the 100k speed pot and limiting resistor. If the ball hits the right-hand bat, gate 3d will register coincidence, and gate 5b will toggle the flip-flop. The 220uF capacitor will now commence to charge up, and the ball will move to the left. When it hits the left bat, its direction is reversed in a similar manner.

The coincidence gates have a further function, not previously mentioned. Gates 6a and 6b are used to differentiate the outputs from the bat controls, giving voltages proportional to the bat velocities. The coincidence gates are used to switch these voltages onto the 1uF vertical speed capacitor at the moment of impact. Transistors TR1 and TR2 act as switches to perform this function, thus allowing the players to partially control the speed and direction of the ball.

If the ball misses one of the bats, the ball flip-flop is not toggled, and the ball continues past the bat and off the screen. Eventually the 220uF capacitor becomes fully charged or discharged, and a stable state is reached. The ball is returned into play by pressing the appropriate serve button, which simply toggles the flip-flop. The speed of play is regulated by the 100k pot which controls the rate of charge or discharge of the 220uF capacitor.

The upper and lower lines on the court are generated by gates 9a, 9b, 9d, 10c and 10d. These combine BL, CL, LL and NH pulses to produce the required video signal, which is injected into the video line by gate 9c. Gates 10a and 10b are used to delay the UL pulses, so that the ball bounces off the bottom of the upper line, rather than the top.

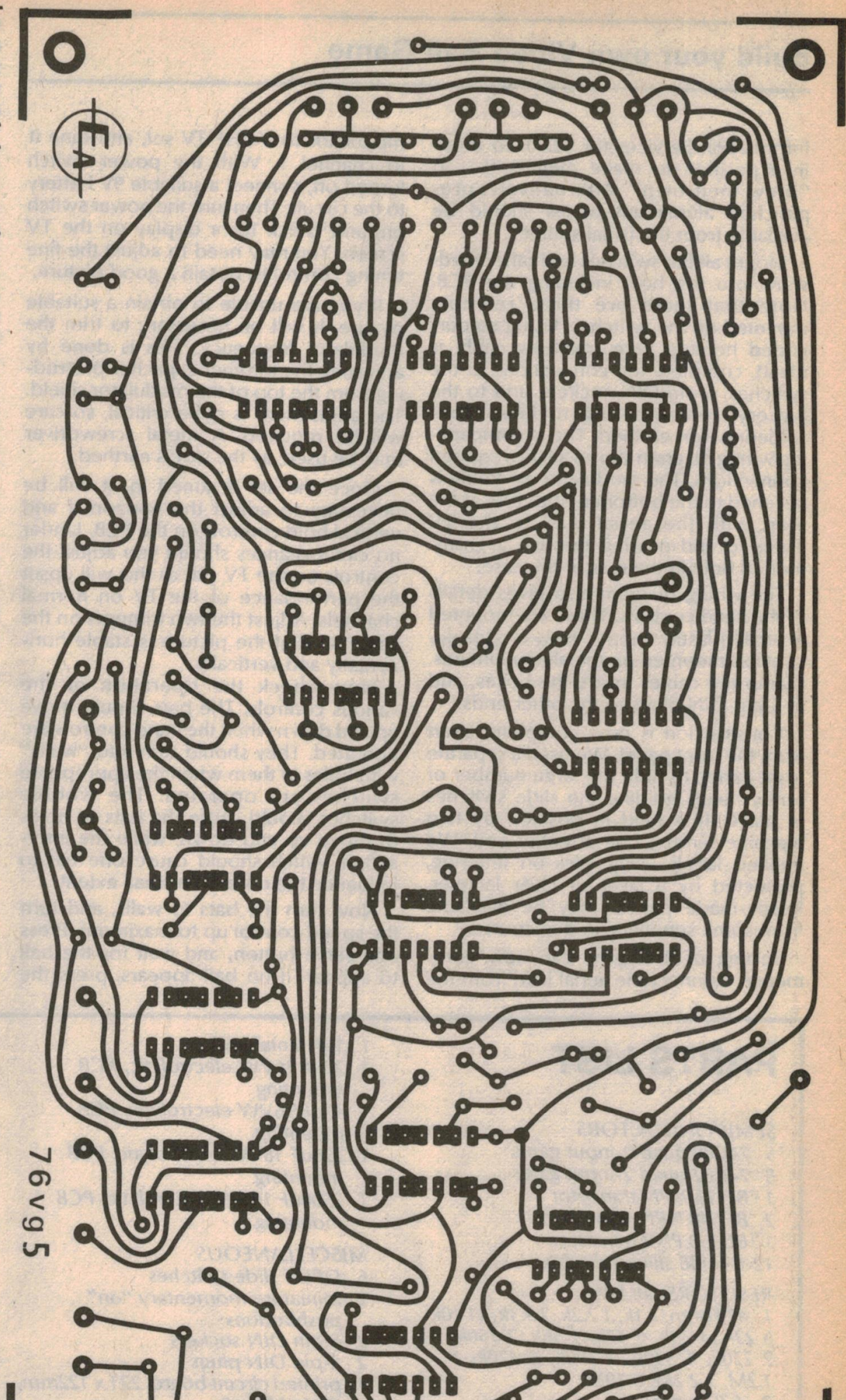
Gates 13d and 12d, which would otherwise be spare, are used to form a very low frequency oscillator. The output from gate 12d is filtered by an RC network, and used to wobble the bats up and down, under the control of switches S5 and S6. Switch S7 connects the wipers of the two bat controls together via a 10k



This wiring diagram will aid in final assembly of the game. To facilitate later tracing of the circuit, use colour coded wire for all interconnections. Lace the wiring into a loom to achieve a neat finish.

Video Ball Game

Shown at right is a full size replica of the printed board pattern, which can be traced if required.



resistor, to provide interaction if this is required.

The power supply for the game is provided by a 9V battery. A 2500uF electrolytic capacitor is used to ensure a low supply impedance, and is connected permanently across the battery. Turn-on transients are eliminated by the 22uF electrolytic capacitor connected on the circuit side of the power switch, S8.

The composite video information, available at the collector of TR4, is fed to the modulator, along with suitable power supply voltages. This modulates the video information onto a carrier centred on 57.25MHz, for demodulation by a VHF TV set tuned to channel 1. The modulator is connected into the aerial socket of the set, so no modifications to the set are required.

Construction of the game is quite simple, as almost all components are mounted on a single printed circuit board. There is a separate board for the modulator. Do not remove the CMOS ICs from their protective packaging until they are to be inserted into the PCB. All other components should be fitted first.

There are 23 wire links to be fitted to the board, none of which need to be insulated. Use tinned copper wire for these (cut-off component leads are ideal).

Next mount all resistors and capacitors, making sure that the polarity conscious capacitors are fitted correctly.

We recommend that circuit board pins be fitted to the 19 external connection points, as this will make final assembly much easier. The twelve diodes and four transistors can be fitted next, taking care that they are inserted with the correct orientation.

The CMOS ICs can now be fitted. It is not necessary to use IC sockets, provided the following procedure is followed. First, ensure that the tip of your soldering iron is earthed, and also earth the PCB, at the — battery terminal. The easiest way to do this is to attach a flying lead to the body of your iron, so that it is in contact with the tip. Fit a crocodile clip to this lead, and simply clip it to the board. Remember to have the clip on for all soldering while you insert the ICs, and also for any soldering later.

The ICs can then be removed from their protective wrapping, and inserted into the board with the minimum of handling. If required, bend the leads by pressing against an earthed metal surface (not plastic) so that they are the required 7.5mm apart. After checking that the IC is in the correct place, and that its orientation is correct, solder first pin 7, and then pin 14. The remaining pins may be soldered in any order, applying a minimum of heat and solder.

When all soldering is finished, spend a few minutes checking the board for solder bridges and misplaced components. A little time spent at this stage may well save a lot of frustration later.

We can now turn our attention to the case and associated components. Metalwork dyelines are available from our

Information Services for $2.00, so those in a position to make metalwork can "brew their own". Alternatively, pre-punched aluminium boxes should be available from the usual sources.

Mount all the switches and other hardware into the box, including the PCB. Note that there are three resistors mounted on the switches. Using colour-coded hookup wire (rainbow cable is ideal), complete the connections to the switches, 5-pin DIN sockets, and to the battery, remembering to keep your soldering iron earthed. The accompanying wiring diagram shows all the required connections. The modulator assembly is fastened to the bottom of the case, at the rear, with the aerial lead to the TV clamped and passing through a grommetted hole in the rear of the case.

The wiring diagram also gives details of the hand controls. These are mounted in small plastic "zippy" boxes, with the controls mounted on the aluminium lids. Clamp the cables inside the boxes, and fit 5-pin DIN plugs to the other ends.

Construction is now complete, apart from the front panel. We used a separate front panel, to hide the large number of screw heads holding the slide switches in place. It is held in position by two machine screws, one at either end. We applied labels using stick-on lettering, protected by a layer of clear lacquer. Ready-made panels may be available from some suppliers, in due course.

Testing of the game can now commence. Connect the aerial lead from the modulator to a VHF TV set, and tune it to channel 1. With the power switch turned off, connect a suitable 9V battery to the circuit. Then turn the power switch on, and check for a display on the TV screen. You may need to adjust the fine tuning control to obtain a good picture.

If you are unable to obtain a suitable picture, it will be necessary to trim the modulator frequency. This is done by adjusting the trimmer capacitor protruding from the top of the modulator shield. The adjustment is quite critical, so care will be required. A metal screwdriver may be used, as the slot is earthed.

Once the set is tuned in, it will be necessary to adjust the horizontal and vertical hold controls on the PCB. Under no circumstances should you adjust the controls on the TV set, as this will upset the performance of the TV on normal channels. Adjust the two trimpots on the game so that the picture is stable horizontally and vertically.

Now check the operation of the various controls. The bats should move up and down when the hand controls are operated. They should turn into "walls" with holes in them when the appropriate switches are operated. The wobble switches should cause the bats or holes to move up and down, while the interaction switch should cause one bat to influence the other to a small extent.

Now turn the bats to walls, and turn the speed control up to maximum. Press one serve button, and wait for the ball to appear. If no ball appears, press the other serve button. If the ball still fails to appear, turn the power off, wait for a little while, and turn it back on again. Once you have found the ball, turn the speed down to a more manageable rate.

The ball should bounce from both walls, and also from the top and bottom lines. If the walls are moving when the ball hits them, some of the wall velocity should be imparted to the ball. The balls should pass through the holes in the walls. Once satisfied that all is correct, return the walls to bats, and commence to play.

To return the ball into play when it has been missed, press the serve button on the opposite side to the one the ball disappeared through. Thus if the ball goes off the left hand side of the screen, press the right hand serve button. The time taken for the ball to return depends on the speed setting and also on how long it has been left off the court.

Various types of game can be played, by appropriate manipulation of the switches. Tennis or ping-pong is played using the bats, while catch-ball requires the use of holes. Single players can have enjoyable games by setting up a wobbling hole in one wall, and trying to hit the ball through this with a bat. Skilful players can enjoy harder games by making their bats or holes wobble, while adding interaction adds to the difficulties yet again.

In fact, the number of different games which can be played is limited mainly by the imagination of the player or players. Be warned, however, that if you have children, you may need to purchase a second TV set, as otherwise you might be forced to miss your favourite program!

PARTS LIST

SEMICONDUCTORS
5 74C00 quad 2-input gates
8 74C02 quad 2-input gates
1 BF173 NPN transistor
2 BC548 NPN transistors
1 BC558 PNP transistor
12 1N4148 silicon diodes

RESISTORS (all ¼W):
1 470 ohm, 2 1k, 1 2.2k, 2 3.3k, 11 10k, 6 22k, 3 33k, 5 47k, 1 56k, 2 150k, 2 220k, 1 330k, 1 390k, 6 470k, 1 1.2M, 1 2.2M, 6 10M
2 4.7k trimpots
2 22k linear pots
1 100k linear pot

CAPACITORS
~~5 100pF~~ polystyrene
1 220pF ~~polystyrene~~
6 330pF polystyrene
2 0.047uF LV polystyrene
8 0.01uF LV polystyrene
2 0.033uF LV polystyrene
5 0.1uF LV polystyrene
1 1uF tantalum
1 22uF 16VW electrolytic, PCB mounting
1 47uF 16VW electrolytic, PCB mounting
1 220uF 16VW electrolytic, PCB mounting
1 2500uF 16VW electrolytic, PCB mounting

MISCELLANEOUS
6 DPDT slide switches
2 miniature momentary "on" pushbuttons
2 5-pin DIN sockets
2 5-pin DIN plugs
1 printed circuit board, 221 x 122mm, coded 76vg5
3 knobs
2 2-metre lengths of 5-core shielded cable, with 2 clamps to suit
2 plastic "zippy" boxes, 80 x 50 x 28mm
1 aluminium case, 230 x 205 x 68mm
1 modulator assembly (see text)
3 grommets
4 rubber feet
1 9V battery and clip
Hookup wire, solder, circuit board pins, machine screws, nuts, washers, self-tapping screws

RF Modulator

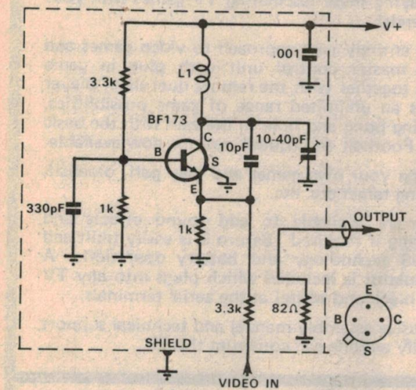
1 BF173 NPN transistor
1 10pF ceramic capacitor
1 10-40pF trimmer capacitor
1 330pF plastic capacitor
1 0.01uF ceramic capacitor
1 82 ohm, 2 lk, 2 3.3k resistors
1 printed circuit board 66 mm x 66 mm, coded 76m5
1 tinplate box, see text
solder, machine screws, nuts, 75Ω co-axial cable, 22 B & S gauge enamelled copper wire

Note: Resistor wattage ratings and capacitor voltage ratings, where given, are those for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Finally, a word about troubleshooting the game, should this be necessary. First of all, check that the battery is okay, as strange things can happen with a flat battery. Next, check the symptoms against the description of operation given earlier, and try to isolate the faulty section. Thus if the ball goes through the left bat only, the trouble is likely to be around gate 3c. If various elements of the picture are scaled incorrectly, then the trouble may be due to incorrect RC networks.

The most likely cause of a complete lack of picture is failure of the horizontal or vertical oscillator. Remember that the circuit works in a logical manner, and you should be able to track down most faults by analysing the fault in conjunction with the circuit diagram.

THE RF MODULATOR



L1 : 10T, 22 B & S ENAMELLED COPPER WIRE, 3mm DIAMETER. SEE TEXT.

VIDEO MODULATOR

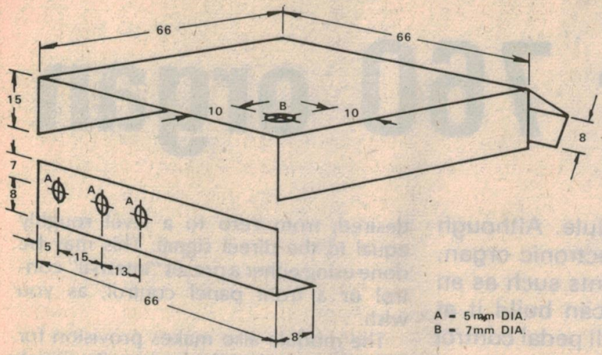
The circuit for the modulator assembly is shown above.

The RF modulator uses a single transistor, an NPN type coded BF173. It is enclosed in a small tinplate box, to minimise spurious radiation. The output has an impedance level of 75 ohms, and is coupled to the aerial terminals of the TV set by a shielded cable.

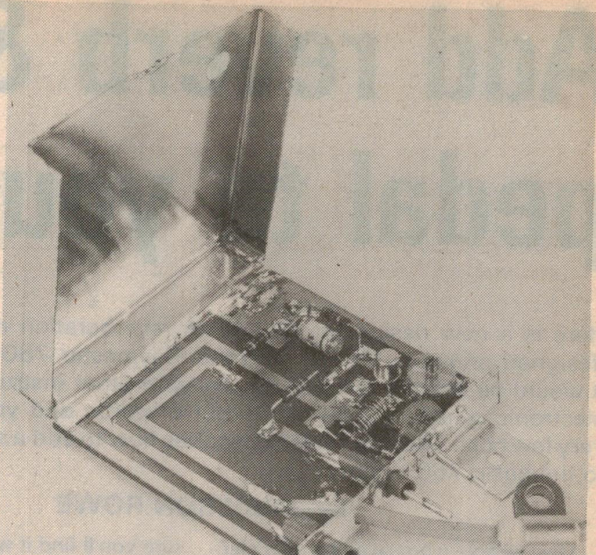
Operation of the modulator can be followed by referring to the circuit diagram. The transistor is connected as a Colpitts oscillator. Base bias is provided by the 3.3k and 1k resistors, connected as a voltage divider across the supply line. AC grounding of the base is provided by the 330pF capacitor.

Frequency of operation is determined by the LC network formed by the inductor in series with the collector and the 10-40pF trimmer shunting the collector to ground. Feedback to maintain oscillation is provided by the 10pF capacitor between emitter and collector.

The input video signal is coupled into the emitter by a 3.3k resistor, and amplitude modulates the oscillator. The RF output signal is "sniffed" by a loop close



Above: This dimensioned drawing of the modulator shield, which is fashioned from tin-plate, will aid construction.



Right: A view of the completed modulator assembly, just prior to spot soldering the lid in position.

to the emitter lead. One end of this loop is terminated with an 82 ohm resistor (the closest preferred value to 75 ohms), while the other end is connected directly to the output cable.

Fine tuning of the oscillator frequency is provided by the trimmer capacitor, while coarse tuning is achieved by varying the number of turns in the inductor. Access to the trimmer capacitor is available from outside the shielding case.

The inductor is fashioned from ten turns of 22 B & S enamelled copper wire, wound with a diameter of 3 mm. In conjunction with the specified trimmer, this allows the modulator to be tuned to channel 1 or channel 2. Reducing the number of turns to 5 enabled us to tune all channels between 3 and 9. Thus if channel 1 or 2 is in use in your area, and you are suffering from interference effects, it is possible to tune the modulator to another, unused channel.

The modulator is constructed on a small printed circuit board, measuring 66 x 66 mm, and coded 76m5. A piece of double sided board is used, with a pattern etched on one side only. The other side acts as a ground plane. All components are mounted on the copper side of the board, so no holes are required in the board itself.

The shield is fashioned from tinplate, obtainable from jamtins, and is made in two pieces. An "L" shaped section with three holes in it forms the front section. The connections to the supply rail, the modulator input and the output are made through these holes.

The second section has a more complicated shape, and forms the lid and remaining sides of the case. It has a single hole in it, to provide access to the tuning capacitor. Dyeline drawings of the shield will be obtainable from our Information Service.

Before the components are mounted on the PCB, it is best to solder the shield to the PCB. The lid can then be hinged upwards, the components fitted, the lid pushed down again, and soldered at selected points. If you are making your own shield, make sure that you drill all the holes before you make the bends, as this makes it much easier.

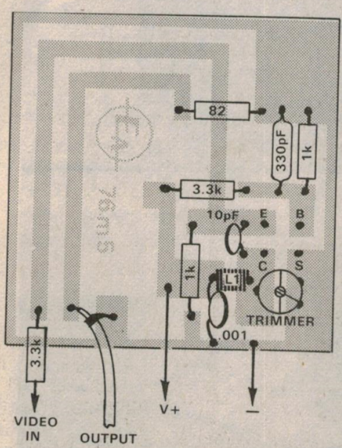
Make suitable bends in the component leads, as required, remembering to keep all components close to the PCB. The coil is wound on a convenient former, such as a knitting needle or similar object, and the ends then cleaned and tinned. The trimmer capacitor must be mounted so that the adjusting screw is aligned with the hole, and so that the earthy side is connected to ground. This will enable a metal screwdriver to be used for adjustment, if desired.

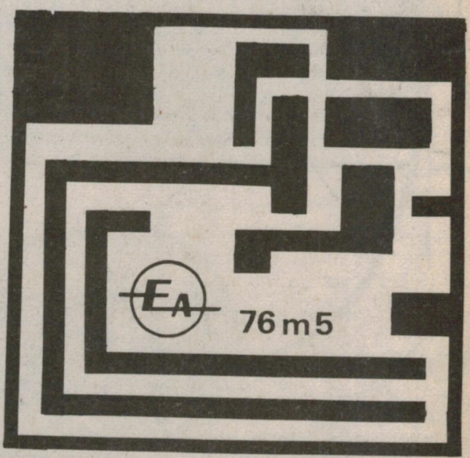
The 3.3k video input coupling resistor is passed partway through the appropriate hole, and soldered to the pattern.

The flying end is used as the terminal point for the lead from the video board. A piece of insulated hookup wire is placed similarly for the positive supply terminal. The earth connection is simply soldered to the shield.

The output co-axial lead is stripped for a short distance at one end, passed through the hole in the shield, and soldered in position. The lid can then be hinged down, and spot soldered in selected places. We fastened it down in position with two small angle brackets fashioned from tinplate.

Once the modulator has been connected to the video section, the TV is tuned to an appropriate channel, and the power switched on. The trimmer is then adjusted to obtain a suitable picture, with good contrast. No sound information is generated by the modulator, so the volume control can be turned right down to eliminate any spurious noise.





At left is the component overlay diagram, while on the right is a full sized copy of the PCB pattern. This should be etched onto one side of a piece of double-sided board, the unetched side acting as a shield.

carries out the AM/PM change at 12 o'clock, suggesting an updated chip design in which other readers might be interested. The new chip is designated TMS3834NC and has the number BA7549 below this designation.

To say that the display is bright is an understatement, as at night with all other lights out I can read my "EA" by it. I considered several ways around this but opted for the simplest method which readers may care to copy.

There is enough room to fit a miniature pot inside the case. Remove the blue +28V transformer lead from the PC board and connect it to one end of the pot. Connect a lead from the centre tap of the pot to the point at which the +28V lead was removed, and connect the other end of the pot to the OV rail. The display can now be varied to suit one's preference. A value of 33k or thereabouts proved most suitable for the pot, and this results in a current drain of less than 1mA extra from the supply. (M.I. Ipswich, Q.)

● Thank you for your information M.I. We have published your letter, in somewhat abbreviated form, for the benefit of other readers who may care to experiment with the brightness control you described. Yes, the clock chip has been modified by the manufacturer to change the AM/PM indication at the correct time.

DOG REPELLERS: In the news lately it has been stated that postmen and meter readers have been bitten and harassed by dogs, and are now being issued with ultrasonic dog repellers. Many people have trouble with dogs which invade gardens and kill plants with their urine.

Q.1: How about a do-it-yourself dog putter-offer?

Q.2: Do you know of any commercial units?

Q.3: Has any frequency unpleasant to dogs been worked out?

Although I have asked three questions, I am sure they could be treated as one, as you will appreciate. (R.L., Merimbula, NSW 2548.)

● While we agree that it may be possible to repel dogs using ultrasonic tones, we have no definite information on this subject. Without such information, it is unlikely that we would be able to describe any device of this type.

NOTES & ERRATA

CALCULATOR STOPWATCH (May, 1976; File No. 7/CL/22). On page 71 it is stated:

"Note that it is necessary to modify the calculator board by cutting the copper track on both sides of pin 1 of the MM5736 chip. The tracks on both sides of pin 1 should be rejoined ... leaving pin 1 isolated."

This step is both unnecessary and incorrect. Pin 1 should remain connected in circuit, and no cuts in the copper tracks of the calculator board are necessary. Note also that one side of switch S2 (labelled stop/start) in Fig. 2 is connected to V+.

VIDEO BALL GAME (May, 1976; File No. 3/EG/8). In the parts list on page 46 there are two misprints. In the first column, the fourth entry from the bottom should read "2 0.0047uF polystyrene". The fifth entry in the RF modulator section should read "1 0.001uF ceramic capacitor". In the circuit diagram on page 39, gates 5a, 5b, 5c and 5d have been shown incorrectly as nand gates instead of nor gates. The list of ICs at the bottom of the diagram is correct.

It has been brought to our attention that some retailers have been supplied with single-sided rather than double-sided PC boards for the modulator. These boards may still be used, provided that an earthed metal plane is provided underneath the board. This can be done by completely enclosing the modulator in a metal box, which should be connected to the earthy part of the pattern.

PLAYMASTER TWIN 25 (May, 1976; 1/SA/56). There is an error in the text on page 59 concerning orientation of the driver transistors: the metal flat on each BD140 faces to the rear of the chassis while on the BD139's it faces to the front. The photograph on page 67 shows the orientation.

QUINTRIX TUBE . . . continued from p.29

Under such conditions, a bright picture is essential to compete with the natural light and help maintain an acceptable contrast. The main difficulty is to produce a convincing black on the TV screen, since the "black" can never be any darker than the colour of the unenergised phosphor.

The brighter picture helps by tricking the eye into seeing the unenergised areas as darker than they really are, when compared with the bright areas. But this trick can only be carried so far. Increasing the brightness beyond a certain level, assuming it is possible, creates other problems, such as increased flicker perception.

This is where the black matrix comes into its own. The reasoning is that the small areas between the dots contribute nothing to the picture but, by reflecting ambient light, help to degrade the blacks. If, on the other hand, these areas are made black, less light is reflected from the screen and, at normal viewing distances, the screen looks significantly darker, thus enhancing the black quality.

This, then, is the basis on which the Matsushita company claims an improved quality picture and one which, more importantly, can be maintained over a wide range of ambient light conditions.

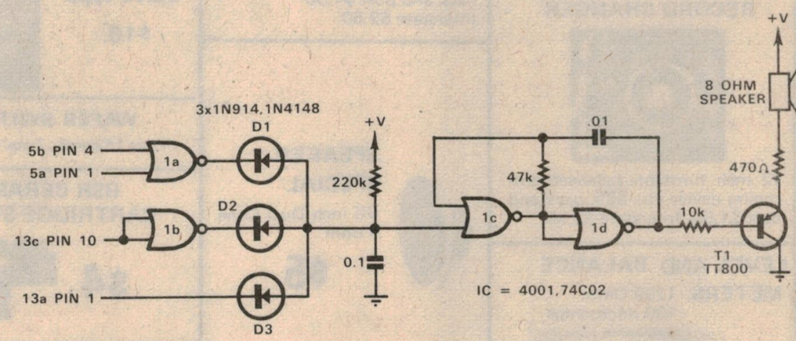
Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Sound effects for video game

I recently constructed the Video Ball Game as described in Electronics Australia for May, 1976. It worked well but it rapidly became boring because of the lack of a "blip" sound when the ball hit the bat or side lines. Because of this I have constructed a simple and cheap circuit that produces a blip when the ball hits either the sides or bats.

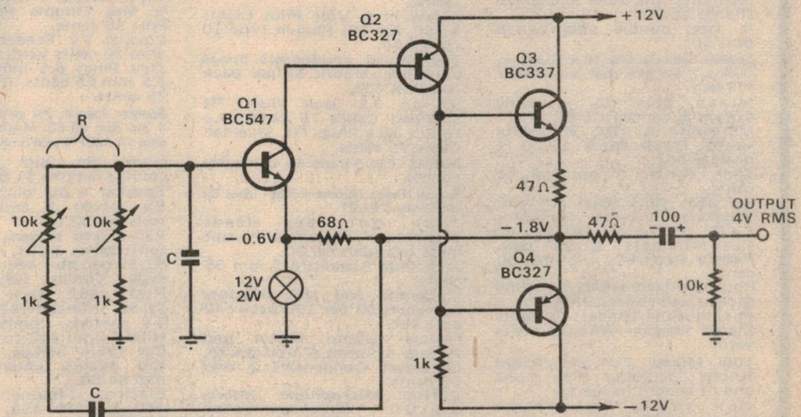


The circuit operation is as follows. Coincidence between the ball and either bat is detected by NOR gate 1a, and NOR gate 1b and D3 detect coincidence between the ball and upper or lower line. This coincidence causes the junction of the 220k resistor and the 0.1uF capacitor to go low and thus allow the oscillator to operate. The resistor and capacitor combination just mentioned stretch the input pulse and cause a blip of about 1/50th of a second. The loudspeaker can be anything from 4 ohms to 100 ohms. Volume is determined by the 470 ohm resistor.

(By Mr M. Hillman, 20 Marcella Street, North Epping, NSW 2121.)

Audio oscillator uses dial lamp for stabilisation

Most Wein bridge oscillators specify thermistor type R53 for stabilisation of the output and although this device is excellent in operation, it is rather expensive and it is now becoming difficult to obtain. The ordinary dial lamp has a similar non-linear characteristic, except that it has a positive rather than negative temperature coefficient. A lamp may be used in place of a thermistor in the feedback loop merely by reversing its position with the resistor.



The R53 thermistor has a cold resistance of about 5000 ohms and an operating resistance of about 2000 ohms at 3mW. The stabilised voltage is 2.5V RMS and the operating temperature is about 50°C. A 12V 2W dial lamp has a cold resistance of about 9 ohms and an operating resistance at 12V of about 71 ohms. If the voltage/current characteristic is plotted, the maximum non-linearity occurs at about 1V and 30mA. This gives an operating resistance of about 33 ohms at 30mW, and the stabilised voltage is 1V RMS at an operating temperature of about 500°C with the lamp just glowing. In the circuit, the output voltage will be three times this voltage or 3V RMS, and this is very similar to that obtained with the R53 thermistor.

The only problem is to design an amplifier which will deliver 30mW to the lamp, but this is quite simple. Unfortunately, it is just beyond the capability of the 741 IC, and a transistor amplifier has been substituted. The amplifier shown has a couple of interesting features and it is entirely satisfactory for the range 1Hz to 100kHz. Positive and negative supplies have been used so that the lamp and Wein networks could be earthed. Hum is then no problem and simple half-wave supplies are used. Current consumption is 25mA. Total power consumption is 300mW and 100mW of this is delivered to the lamp and 68 ohm resistor combination.

The Wein network forms the positive feedback to the transistor base and resistor values from 1k to 100k are permissible. Capacitance values from 470pF to as high a value as required may also be used. The 68 ohm resistor and the lamp form the negative feedback loop to the transistor emitter. If desired, the output may be varied over the range of 2V to 8V by varying the 68 ohm resistor from about 39 ohms to 100 ohms.

The lamp is also part of the DC feedback loop, and since the transistor base is effectively grounded by the Wein net-

Sound effects for your Video Ball Game

Since our Video Ball Game was published in the May 1976 issue, we have had many letters and enquiries from readers about possible sound and scoring circuits for the game. We have also had quite a few suggestions from other readers on how to accomplish this. In this article, we present an amalgamation of these ideas.

by DAVID EDWARDS

The basic game as published did not contain any provision for sound or scoring circuits. This was partly intentional, in order to keep the basic kit price as low as possible. However, as quite a few readers have demonstrated, a sound circuit may be implemented fairly easily with the addition of only a few extra devices.

Of course, such sound circuits do not use the sound system of the TV set, but instead use a separate speaker. This is because the addition of a sound carrier to the video modulator is much harder to achieve than the addition of a speaker and appropriate drive circuitry to the game itself.

The addition of scoring facilities is more difficult. Seven segment displays and the associated drive and counting circuitry could be added to the existing circuitry, and provided due regard was taken of the increased battery drain, would probably perform adequately. But because the player's attention is normally directed to the TV screen, the addition of this type of scoring may tend to be distracting.

It is generally regarded as more desirable to have the scores appear on the screen. There are two possible ways of achieving this. Firstly, digital scores could be superimposed on the video for the game, to appear say in the top corners of the screen. In terms of the display circuitry alone, however, this method is quite complicated, and beyond the scope of a simple addition.

The second method is to have a bar graph type of display. This would be much simpler electronically, but would still necessitate fairly extensive modifications to the basic game circuitry.

But the real problem about trying to add on-screen scoring to our video game is that in the near future LSI video game chips will become readily available with these facilities inbuilt. These will supersede not only external sound and scoring circuits, but the whole ball game itself!

In the meantime, however, the Video Ball Game is still capable of providing hours of enjoyment for all the family, and provided it is simple, an add-on sound circuit can be worthwhile.

The add-on sound circuit we are presenting in this article is an amalgamation of our own ideas, and of those interested readers.

Circuits, comments and ideas were received from the following readers: M. Hillman, of North Epping, NSW; L. Collins, of Arncliffe, NSW; D. Hainsworth, of the University of Queensland, St. Lucia, Qld; K. Bolton, Howrah, Tasmania.

The circuit uses a minimum of parts, and gives quite acceptable performance. Sounds are produced when the ball strikes either bat, and when the ball is served. Two different sounds are produced, one when the ball is struck by the left bat, and one when the ball is struck by the right bat.

Only four connections to the main PCB are required: two power supply leads, and two connections to the ball direction flipflop formed by gates 5c and 5d (refer to the diagram on page 39 of the May 1976 issue).

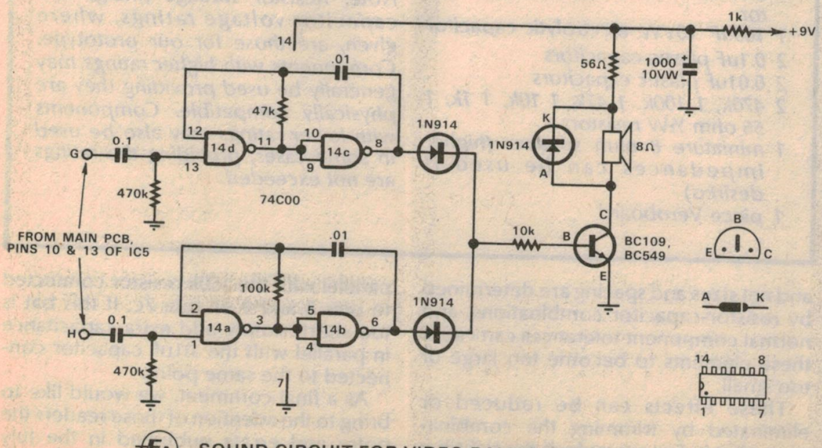
The horizontal direction of the ball is determined by the previously mentioned flipflop. Let us suppose that the ball is moving to the right. Point G, the output of gate 5c will be low, and point H, the output of gate 5d will be high. Pins 1 and 13 of IC14 (the additional gate, numbered sequentially to correspond with the previous system) will be held low by the 470k resistors.

This will prevent the two oscillators formed by gates 14a and 14b, and 14d and 14c from operating, so no sound will be produced by the speaker. This state of affairs will continue until the ball is deflected by the right bat

When this happens, point G will go high, and point H low. Point H going low will only cause gate 14a to remain held off, so that the associated oscillator will not operate. But when point G goes high, gate 14d will be enabled for a short time, and during this period the oscillator will function, causing the speaker, controlled by the transistor, to emit sounds.

The duration of the sound is determined by the time constant of the resistor–capacitor combination. With the values as shown, the sound will last for approximately 1/30th of a second.

This oscillator has an approximate



SOUND CIRCUIT FOR VIDEO BALL GAME

3/EG/—

LEFT: This is the circuit diagram for the sound effects module. Only four leads connect to the main PCB.

frequency of 1kHz, and the resulting sound can be described as a "ping". In a similar fashion, the second oscillator is gated on when the ball strikes the left bat, but this time, since the oscillator frequency is lower, a "pong" is produced.

These sounds will also be produced when the ball is served, since serving also toggles the ball the direction flip-flop. A diode OR gate is used to feed the oscillator outputs to the transistor base, to prevent interaction between the oscillators. Speaker current is limited by the 56 ohm resistor. Higher impedance speakers can be used without changes, although lower impedance ones can not. Louder sounds will be produced by higher impedance speakers, and this may be advantageous in some cases.

Supply decoupling is provided by the 100uF/1k capacitor/resistor combination. This prevents the speaker current from modulating the main supply rail, and hence visibly affecting the TV picture.

Construction should present no difficulties, as there is a minimum of parts. We suggest that the circuit be constructed on a small piece of Veroboard, with colour coded hookup wire used to connect the main circuit board. The +9V supply can be obtained from point B (see the PCB overlay on page 41 of the May 1976 issue), and an earth connection at point A.

Points G and H on the circuit diagram (page 39) correspond to points H and D on the PCB overlay (page 41).

The speaker can be mounted behind a group of holes drilled in the top cover (there is no room left on the base of the chassis), with long enough leads to enable the cover to be easily removed for battery replacement. Mount the Vero board on one of the speaker mounting screws.

The usual precautions reguarding CMOS devices should be observed during construction, with the 74COO mounted in a socket if you are at all doubtful of your capabilities. Testing simply consists of trying out the game.

Before concluding, some of the comments made by reader Mr D. W. Hainsworth of the University of Queensland may be of help to other readers. His first suggestion is that a 330k resistor inserted into the link between the emitters of TR1 and TR2 will give an improvement in the dynamics of the ball/bat collision, while still allowing an adequate amount of slice to be imparted to the ball. This overcomes a slight defect caused by offsets in the bat vertical velocity differentiators, gates 6a and 6b.

He also suggests that flicker of the top and bottom lines can be reduced by loosely coupling the horizontal and vertical timebase oscillators. This can be done by connecting a 100k resistor between the two sync outputs.

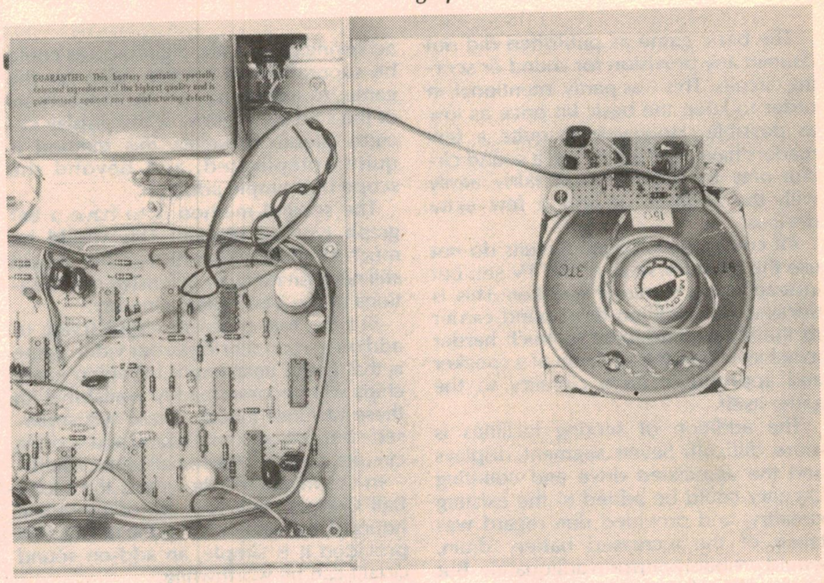
A number of readers have written to ask about the proportions of the court and its various elements. The ball, bat and net sizes and spacing are determined by resistor-capacitor combinations, and normal component tolerances can cause these elements to become too large or too small.

These effects can be reduced or eliminated by trimming the combinations to suit. For example, if the right bat is too long, add extra resistance in parallel with the 150k resistor connected to pins 8 and 9 of gate 7c. If this bat is too short, simply add extra capacitance in parallel with the .01uF capacitor connected to the same point.

As a final comment, we would like to bring to the attention of those readers the notes and errata published in the July 1976 issue.

ABOVE: This photograph shows how the speaker is mounted in the lid of the main chassis.

BELOW: The way in which the Veroboard assembly is held by one of the mounting screws is shown in this photograph.



PARTS LIST

1 74C00 quad NAND gate
3 1N914 silicon diodes
1 BC109, BC549 silicon NPN transistor
1 100uF 10VW electrolytic capacitor
2 0.1uF plastic capacitors
2 0.01uF plastic capacitors
2 470k, 1 100k, 1 47k, 1 10k, 1 1k, 1 56 ohm ½W resistors
1 miniature 8 ohm speaker (higher impedances can be used it desired)
1 piece Veroboard

Solder, hookup wire, machine screws, nuts, washers

Note: Resistor wattage ratings and capacitor voltage ratings, where given, are those for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.

Circuit & Design Ideas

Conducted by Ian Pogson

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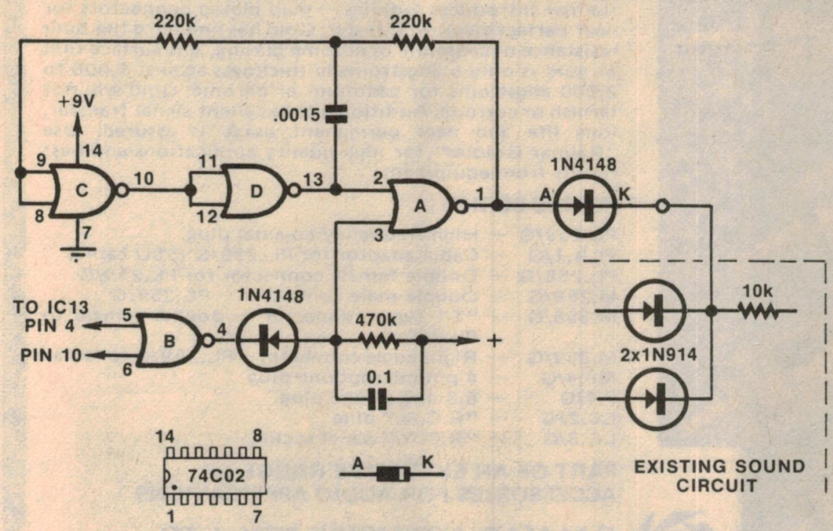
Video ball game sound addition



The Video Ball Game, described in May, 1976, and the add-on unit for sound, in November 1976, both work very well, the sound providing added realism. The sound unit, however, did not incorporate a provision for sound when the ball bounces off the top and bottom walls. The circuit shown here provides this facility without modification to either of the previously published circuits.

The oscillator (gates A, C, D) is gated on when gate B detects coincidence between the ball and either the upper or lower walls. This pulse is inverted and stretched by the RC network at the output of gate B. The diode ensures that the capacitor is charged only via the 470k resistor.

Constructional layout is not critical but the usual precautions regarding the handling of CMOS devices should be observed. Power should NOT be applied until pins 5 and 6 of the IC are properly connected to the Video Ball Game (pins 4 and 10 of IC13). I used ¼W resistors and "greencap" capacitors.

(By Mr P. M. Jardine, 31A Queen Street, Caloundra, Qld 4551.)

RF operated aerial switch

This aerial switch offers good isolation and negligible attenuation without the use of high voltage bias supplies. The unit is simply connected into the aerial lead and no connections are made to the receiver or transmitter power supplies.

When an RF signal appears in the dummy load, a sample is picked up by the coil, rectified, and used to turn on the transistor circuit. The relay then changes to transmit. When the RF ceases the discharge of C produces a small delay so that the relay only switches at the beginning and end of a CW transmission. The switch to transmit is rapid and a 100uF x 15k produces a delay of two seconds when switching to receive.

The few turns on a toroid is sufficient for a pickup coil with an output of 1W. In the receive condition the circuit requires only 30uA so a battery can be left in circuit. With short leads and the unit mounted in a screened case, the circuit functions from 1.8MHz. The transistors are general purpose silicon types but D1 and D2 should be germanium.

(By I. Braithwaite, in "Wireless World".)